CHROMOSOME NUMBERS IN ANNUAL LINANTHUS SPECIES

Robert Patterson
Department of Ecology and Systematic Biology
San Francisco State University, San Francisco, CA 94132

Abstract

Chromosome numbers are reported for nineteen species of *Linanthus,* of which 15 are new counts. These establish further the base chromosome number for the genus as $x = 9$. Based on these counts, polyploidy appears to be extremely rare in annual species of *Linanthus*.

Chromosome numbers of all 19 genera of the Polemoniaceae have been determined since the initial work of Flory (1937). Certain genera have been studied chromosomally in some detail, including *Gilia* (Grant, 1950, and papers following), *Phlox* (Smith and Levin, 1967), *Ipomopsis* (Grant, 1956), and *Allophyllum* (Grant and Grant, 1955). Other genera in the family consist of so few species that chromosome numbers are known for all, e.g. *Gymnosteris* (McMillan, 1949; Grant, 1959) and *Microsteris* (Mason, 1941; Kinch, 1956). There are, however, genera that are relatively unknown chromosomally, with counts being restricted to a small percentage of their species. The predominantly Californian genus *Linanthus* is one example. Among 42 species, only thirteen have had chromosome numbers determined (Flory, 1937; Heuther and DeJong, 1970; Hartman and Crawford, 1971; Patterson, 1977). In this paper I present chromosome numbers for 19 species of *Linanthus* (15 of them first reports), and discuss the results in terms of their bearing on the systematics of the family.

Methods

Members of 19 species of *Linanthus* were surveyed chromosomally from collections made during the spring and summer of 1977 and 1978. Floral buds were collected in the field and fixed in Newcomer's fixative. Preparations were made according to the method of Beeks (1955) and stained with aceto-carmine. All counts were made from microsporocytes during diakinesis or metaphase I. Voucher specimens have been deposited at UCSB.

Results

All of the populations examined possessed a chromosome number of $2n = 18$ (Table 1). There appeared to be some difference in size of chromosomes among different species, but the course of meiosis appeared normal in all samples. Populations examined chromosomally are listed in Table 1.

TABLE 1. TAXA OF ANNUAL *Linanthus* EXAMINED CHROMOSOMALLY. All taxa were $2n = 18$, and all collections are from California. Patterson collections are abbreviated to P. Asterisk denotes taxa for which chromosome numbers are previously unreported. Voucher specimens are in UCSB.

Sect. *Dactylophyllum*

**L. ambiguus* (Rattan) Greene. San Benito Co., Clear Creek, *P & P 1279*; Hernandez Road, *P & P 1281*.

L. aureus (Nutt.) Greene subsp. *aureus*. San Bernardino Co., Camp Rock Road, *P 1159*; Old Woman Springs Road, *P & P 1247*. Kern Co., Kelso Creek Road, *P 1174*. Inyo Co., Lone Pine Creek Campground, *P 1260*.

**L. aureus* (Nutt.) Greene subsp. *decorus* (Gray) Jeps. San Bernardino Co., Morongo Valley, *P & P 1155*.

**L. filipes* (Benth.) Greene. Madera Co., Bass Lake, *P & P 1034*. Tulare Co., Coffee Campground, *P 1290*.

**L. lemmonii* (Gray) Greene. Riverside Co., 13 km S of Corona, *P & Howald 1234*.

**L. liniflorus* (Benth.) Greene. Monterey Co., Memorial Campground, *P 1167*; Camp Hunter-Liggett, *P & P 1285*.

**L. pygmaeus* (Brand) J. T. Howell subsp. *continentalis* Raven. San Benito Co., Clear Creek, *P & P 1280*.

Sect. *Dianthoides*

**L. demissus* (Gray) Greene. Inyo Co., Saline Valley Road, *P 1259*.

L. dianthiflorus (Benth.) Greene. Santa Barbara Co., Los Prietos Campground, *P & Tanowitz 1231*.

**L. parryae* (Gray) Greene. San Bernardino Co., Mojave-Randsburg Road, *P 1254*. Inyo Co., Lone Pine Creek Campground, *P 1261*.

Sect. *Leptosiphon*

**L. androsaceus* (Benth.) Greene subsp. *luteolus* (Greene) Mason. San Diego Co., Sunrise Highway, *P, Mason, Trager, & Nemzer 1304*; S of Laguna, *P, Mason, Trager, & Nemzer 1309*; Palomar Mountains, *P, Mason, Trager, & Nemzer 1311*.

L. androsaceus (Benth.) Greene subsp. *micranthus* (Steud.) Mason. San Luis Obispo Co., Friis Campground, *P 1164*. Monterey Co., Memorial Campground, *P 1166*; Parkfield, *P & P 1276*.

**L. bicolor* (Nutt.) Greene. Madera Co., Bass Lake, *P & P 1036*. Kern Co., Bodfish-Caliente Road, *P 1292*.

**L. breviculus* (Gray) Greene. Los Angeles Co., Table Mountain Campground, *P, Mason, Trager, & Nemzer 1315*; West of Bigpines, *P, Mason, Trager, & Nemzer 1316*.

L. ciliatus (Benth.) Greene var. *ciliatus*. Santa Barbara Co., Los Prietos Campground, *P & Tanowitz 1233*. Kern Co., Rancheria Road, *P 1171*. Madera Co., Bass Lake, *P & P 1061*. Tuolumne Co., W of Dodge Ridge, *P, Mason, Allen, & Santarosa 1320*. San Benito Co., Hernandez Road, *P & P 1282*.

** L. ciliatus* (Benth.) Greene var. *neglectus* (Greene) Jeps. Mono Co., E of Sonora Pass, *P, Mason, Allen, & Santarosa 1322*.

L. montanus (Greene) Greene. Madera Co., Bass Lake, *P & P 1035*. Tulare Co., Balch Park Road, *P 1286*.

**L. nudatus* Greene. Tulare Co., Troy Meadows, *P, Wall, & Ikeda 1190*; Fish Creek, *P, Smith, & Steele 1215*; Sherman Pass Road, *P 1291*.

Sect. *Pacificus*

L. grandiflorus (Benth.) Greene. Marin Co., Point Reyes, *P & Meyers 1294*.

TABLE 1. Continued.

Sect. *Linanthus*

**L. bigelovii* (Gray) Greene. San Bernardino Co., Black Rock Campground, *P & P 1246*. Tulare Co., Chimney Peak Campground, *P 1268*. Inyo Co., Lone Pine Creek Campground, *P 1262*.

L. dichotomus Benth. Kern Co., Willow Springs Road, *P 1237*. San Luis Obispo Co., E of Santa Margarita, *P 1240*; Friis Campground, *P 1241*.

**L. jonesii* (Gray) Greene. Riverside Co., Aqueduct Road, *P & P 1243*.

DISCUSSION

In his monographic study of the Polemoniaceae, Grant (1959) considered the base chromosome number of *Linanthus* to be $x = 9$. This determination was based on the earlier counts by Flory (1937) of 5 species: *L. androsaceus* subsp. *micranthus, L. aureus, L. dianthiflorus, L. dichotomus,* and *L. grandiflorus*. Although these five species represent five of the six sections of *Linanthus,* they make up only 12 percent of the species. The chromosome counts in this report, along with those of Heuther and DeJong (1970), Hartman and Crawford (1971), and Patterson (1977), constitute 57 percent of the species in the genus, thereby reinforcing the base chromosome number of *Linanthus* as $x = 9$.

Heuther and DeJong (1970), studying members of *Linanthus* sect. *Leptosiphon,* found *L. montanus* and certain populations of *L. ciliatus* to possess chromosome numbers of $2n = 16$; however, all populations of these species examined in the present study had chromosome numbers of $2n = 18$ (Fig. 1). Populations studied by Heuther and DeJong were not among those examined here. It would be worthwhile to investigate further the chromosome numbers of these two species, because the populations with $2n = 16$ might represent the beginnings of new evolutionary trends. Two other genera in the Polemoniaceae, *Allophyllum* and *Gilia,* have been shown to possess two base chromosome numbers, $x = 8$ and $x = 9$ in both cases. Hence the possibility exists that similar patterns of chromosome evolution have taken place in these three genera.

It is also noteworthy that the occurrence of polyploidy in *Linanthus* is relatively rare and restricted to two perennial species, *L. melingii* and *L. pachyphyllus* (Patterson, 1977), and one annual species, *L. ciliatus* (Heuther and DeJong, 1970). This is in marked contrast to the related genus *Gilia,* where 32 percent of the species are polyploid (Grant, 1959), and where polyploidy has played an important role in the evolution of this genus (Day, 1965; Grant, 1954a, 1954b, 1964, 1965, 1966; Grant and Grant, 1956; Grant et al., 1956). This suggests that the role of polyploidy is probably minor in the evolution of the annual species of *Linanthus*.

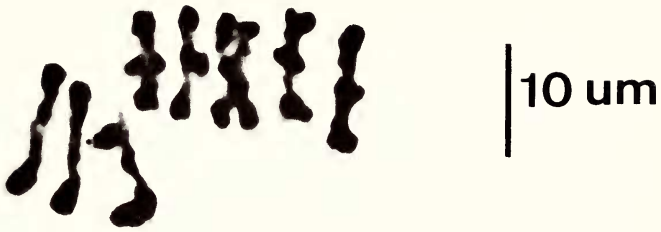

FIG. 1. Metaphase I configuration of *Linanthus ciliatus* (*Patterson & Tanowitz 1233*) showing $2n = 9$ II. Voucher deposited at UCSB.

ACKNOWLEDGMENTS

Appreciation is extended to the students in my plant taxonomy classes at Occidental College and Santa Barbara City College for their aid during collecting trips.

LITERATURE CITED

BEEKS, R. M. 1955. Improvements in the squash technique for plant chromosomes. Aliso 3:131–134.

DAY, A. 1965. The evolution of a pair of sibling allotetraploid species of Cobwebby Gilias (Polemoniaceae). Aliso 6(1):25–75.

FLORY, W. S. 1937. Chromosome numbers in the Polemoniaceae. Cytologia, Fujii Jub. Vol.:171–180.

GRANT, A. and V. GRANT. 1955. The genus *Allophyllum* (Polemoniaceae). Aliso 3:93–110.

———. 1956. Genetic and taxonomic studies in *Gilia*. VIII. The Cobwebby Gilias. Aliso 3:203–287.

GRANT, V. 1950. Genetic and taxonomic studies in *Gilia*. I. *Gilia capitata*. Aliso 2:239–316.

———. 1954a. Genetic and taxonomic studies in *Gilia*. V. *Gilia clivorum*. Aliso 3:19–34.

———. 1954b. Genetic and taxonomic studies in *Gilia*. VI. Interspecific relationships in the leafy-stemmed Gilias. Aliso 3:35–49.

———. 1956. A synopsis of *Ipomopsis*. Aliso 3:351–362.

———. 1959. Natural history of the *Phlox* family. Vol. 1, Systematic Botany. Martinus Nijhoff, The Hague.

———. 1964. Genetic and taxonomic studies in *Gilia*. XII. Fertility relationships of the polyploid Cobwebby Gilias. Aliso 5:479–507.

———. 1965. Species hybrids and spontaneous amphiploids in the *Gilia laciniata* group. Heredity 20:537–550.

———. 1966. Genetic and taxonomic studies in *Gilia*. XIII. The *Gilia laciniata* group. Aliso 6(2):67–80.

———, R. M. BEEKS, and H. L. LATIMER. 1956. Genetic and taxonomic studies in *Gilia*. IX. Chromosome numbers in the Cobwebby Gilias. Aliso 3:289–296.

HARTMAN, R. L. and D. J. CRAWFORD. 1971. I.O.P.B. Chromosome number reports. Taxon 20:158–159.

HEUTHER, C. A. and D. C. D. DEJONG. 1970. I.O.P.B. Chromosome number reports.Taxon 19:438.

KINCH, W. 1956. A systematic study of *Microsteris* (Polemoniaceae). Unpublished thesis, Claremont, California.
MASON, H. L. 1941. The taxonomic status of *Microsteris* Greene. Madroño 6:122–127.
MCMILLAN, C. 1949. Documented chromosome numbers of plants. Madroño 10:95.
PATTERSON, R. 1977. A taxonomic revision of *Linanthus* sect. *Siphonella*. Madroño 24:36–48.
SMITH, D. M. and D. A. LEVIN. 1967. Karyotypes of eastern North American *Phlox*. Amer. J. Bot. 54:324–334.

(Accepted 19 Jan 1979.)

NOTEWORTHY COLLECTIONS

DISTICHLIS SPICATA var. STRICTA (Torr.) Beetle (POACEAE).—Ecuador, Galapagos Islands, Gardner Bay, Española, 12 Jan 1975, *Norman and James s.n.* (US); Feb 1977, *Falco s.n.* (Darwin Research Station Herbarium). A single population 10 m by 20 m in bare sandy area subject to occasional wave action and salt spray (Porter, pers. comm., 1978). Both specimens with ♀ inflorescences. Verified by A. A. Beetle, Jan 1978 (*Falco s.n.*).

Previous knowledge. Known from W N.A., S to Chile and in Australia (Beetle, pers. comm., 1978). Specifically excluded by Reeder and Reeder in Wiggins and Porter (*Flora of the Galapagos Islands*. 1971) because earlier report was based on misindentification.

Significance. 800 km disjunction. Probably recent introduction to the archipelago. Perhaps only ♀ plants present.—ELIANE M. NORMAN, Department of Biology, Stetson University, DeLand, FL 32720. (Accepted 31 Mar 79.)

CROSSOSOMA CALIFORNICUM Nutt. (CROSSOSOMATACEAE).—USA, CA, Los Angeles Co., Palos Verdes Peninsula, Rancho Palos Verdes, 33°44′22″N, 118°20′45″W, 5 Dec 1977, *Henrickson 16341* (RSA, CSLA) in fruit; 10 Jan 1979, *Henrickson 17810* (CAS, CSLA, RSA, SB) in flower. Two plants observed at ca. 175 m, ca. 165 m NE of Forrestal Dr., NE of Ladera Linda Elementary School at base of granitic NW-facing slope at mouth of steep abandoned granite quarry. Lower plant ca. 2.4 m high, 2.2 m wide, upper plant ca. 2.5 m high, 3.5 m wide with basal stem to 54 mm. In coastal sage scrub vegetation with *Artemisia californica, Rhus integrifolia, Salvia mellifera, Eriogonum cinereum, Dudleya lanceolata,* and *Galium angustifolium* var. *angustifolium*.

Previous knowledge. Known only from 3 Channel ids.: San Clemente Id. where rare in 1 population on W slope at 460 m (Raven, Aliso 5:289–347. 1963); Santa Catalina Id. where common from 5–490 m (Thorne, Aliso 6(3):1–77. 1967); and Guadalupe Id. where rare and now restricted to rocky, inaccessible exposures from 50 to 950 m. It also occurs on Outer Islet, a small rocky island at the S end of Guadalupe Id. not inhabited by goats. (Moran, pers. com.)

Significance. First record from mainland USA, however, it must be noted that "the Palos Verdes Hills area was an island itself until joined to the mainland during the Quaternary (Pleistocene or Recent)" (Valentine and Lipps, *In* Philbrick, Proc. Symp.